Research Needs in

Critical Infrastructure Protection

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Agenda

- **Background**
- **The Hard Issue -- Interdependencies**
- **Some Considerations and Constraints**
- **Where We're Heading…**
- **Questions**

History

- **President Clinton issued PDD-63 on May 22, 1998**
- **PDD-63 key milestones:**
  - **2000: Initial operational capability**
  - **May 2003: achieve and maintain capability to protect nation's critical infrastructures**
- **R&D can do little to meet these short-term goals**
- **R&D <u>essential</u> to meet the technical needs beyond 2003**

Major Categories and Issues

- Orientation along infrastructure sectors
- Realization of interdependent nature of the problem
- Public-Private cooperation is needed
- Technology changes

The Hard Issue

Mutual dependence and the interconnectedness … lead to the possibility that our infrastructures may be vulnerable in ways they never have been before.

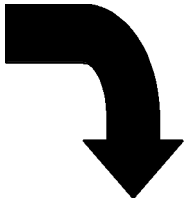
A series of incidents … could interact (cascade) across critical infrastructures to degrade the service upon which all depend.

Intentional exploitation of these new vulnerabilities (i.e., interdependencies) could have severe consequences for our economy, security, and way of life.

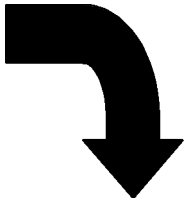
Report of the President's Commission on Critical Infrastructure Protection, October 1997

Framing the Issue

- **Users and Applications**
  - *Consequence Management*
  - *Vulnerability/Risk Analyses*
  - *Business Continuity*



- **Models and Simulations**
  - *Nodal analyses*
  - *Agent-based models*
  - *Scaling/databases/granularity*
  - *Legacy codes*



- **Enabling Technologies**
  - *Statistical analyses/Data mining*
  - *Complex adaptive systems*
  - *Emergence/order*

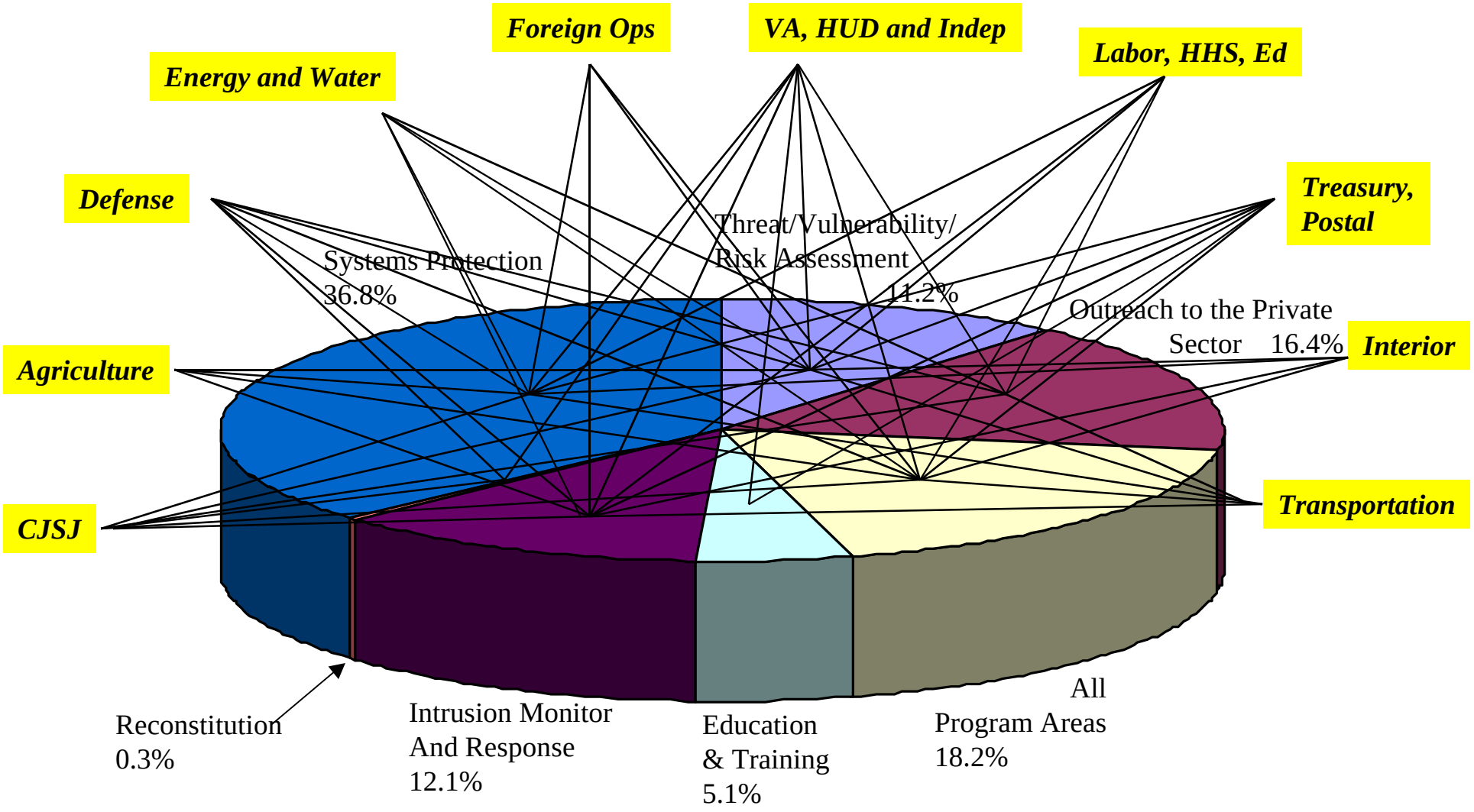
Considerations and Constraints

- **Current state of understanding is limited**
  - **Our fundamental comprehension of the interdependencies issue is still developing**
  - **State of modeling, simulation, databases, etc (i.e. tools for understanding) still maturing**
- **Level and intensity of existing R&D growing, but insufficient**
  - **Content and direction of existing R&D portfolios**
  - **Budgetary "interconnectivities"**
- **Cooperation and collaboration (government, industry, academia)**
- **Human resources issues**
  - **Base of existing researchers in this field**
  - **Academic production of graduate-level researchers**

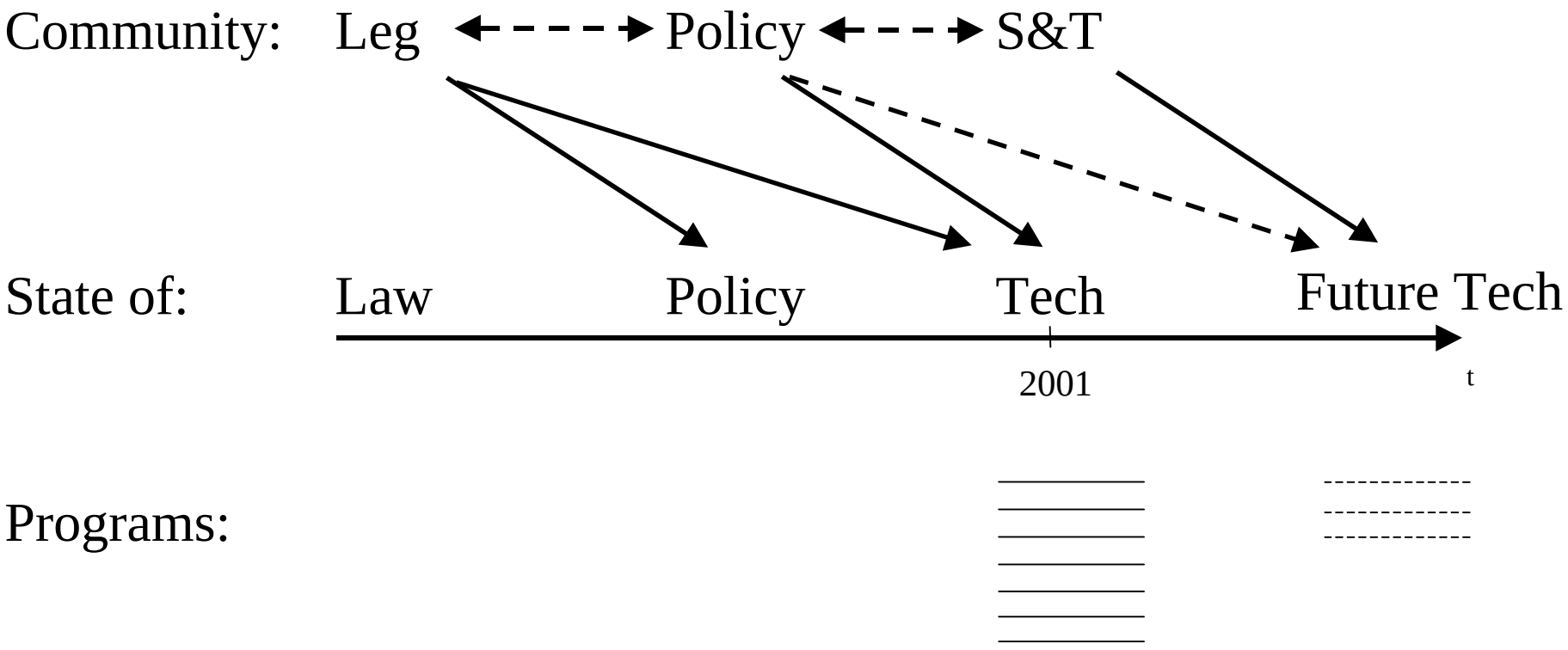
Considerations and Constraints (Continued)

- **Data availability and sharing**
  - **Industry owned and operated infrastructures**
  - **Trust**
  - **Proprietary and sensitive information/legal concerns**
- **Security concerns**
- **Raising awareness and "education"**
- **Overlapping authorities and responsibilities**
- **Policy**
  - **Requirements/regulations**
  - **Unintended consequences**

Congressional Dilemma



The Future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R&D Guiding Principles

- Focus on True Cross-Infrastructure Behavior
- Holistic, Systems Approach
- Near and Long-term Focus
- Enhanced Resiliency and Robustness
- Vulnerability Orientation
- Consequence Orientation

Research Objectives

- **Build a theoretical framework for understanding interdependencies**
- **Develop the requisite modeling and simulation capabilities**
- **Develop metrics for measuring impacts of interdependency related disruptions**
- **Develop technologies and techniques to contain, mitigate and defend against interdependency related disruptions**
- **Develop testing methodologies**
- **Develop the ability to characterize and incorporate new critical infrastructures into existing models and methodologies**

Where We're Headed

- **Influx of new technologies will change the security and reliability paradigms -- need to engineer these qualities into the new systems**
- **A vision of infrastructures immune to interdependency-related failures…**
  - **… A detailed understanding of interdependencies among the infrastructures and their operational implications**
  - **… New technologies, processes, and best practices to contain, dissipate, and mitigate such disruptions**
- **A goal of a set of robust, dynamic policy/analytic/management tools to address interdependency issues**
- **A strong, constructive dialog among government, industry, and academia on interdependencies-related issues**

Questions

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